7 Rivers and Streams

Questions to consider

1. What are the parts of a stream? How do they function together?
2. What is the riparian zone? Why is it important to have plenty of plants growing alongside a stream?
3. What is the floodplain? Are floods natural disasters?
4. What is stream order? How can it help us understand the aquatic community living in a particular place?
5. What can the presence or absence of aquatic invertebrates tell us about the health of a stream?
6. How are plants and animals adapted to living in flowing water?
7. How can rivers and streams be kept healthy?

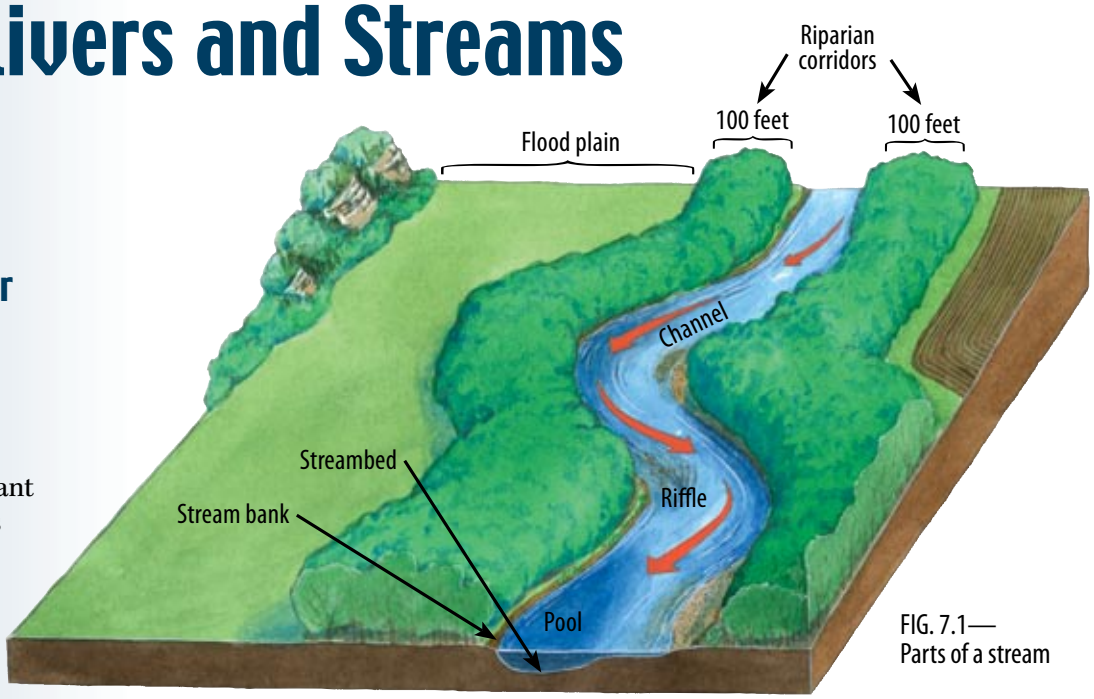


FIG. 7.1—Parts of a stream

Anatomy of a stream

When most people think of a stream, they're really thinking of the stream **channel**. (FIG. 7.1) The channel is the part of the stream where water collects to flow downstream. Stream channels always run downhill. In a straight stretch of river, the main force of the current is in the middle. The deepest water is also in the middle. The part near the shore is the shallowest. When there is a sharp bend in the river, however, the strongest current and deepest water is at the outside edge of the bend. In flowing water, there is less current near the bottom.

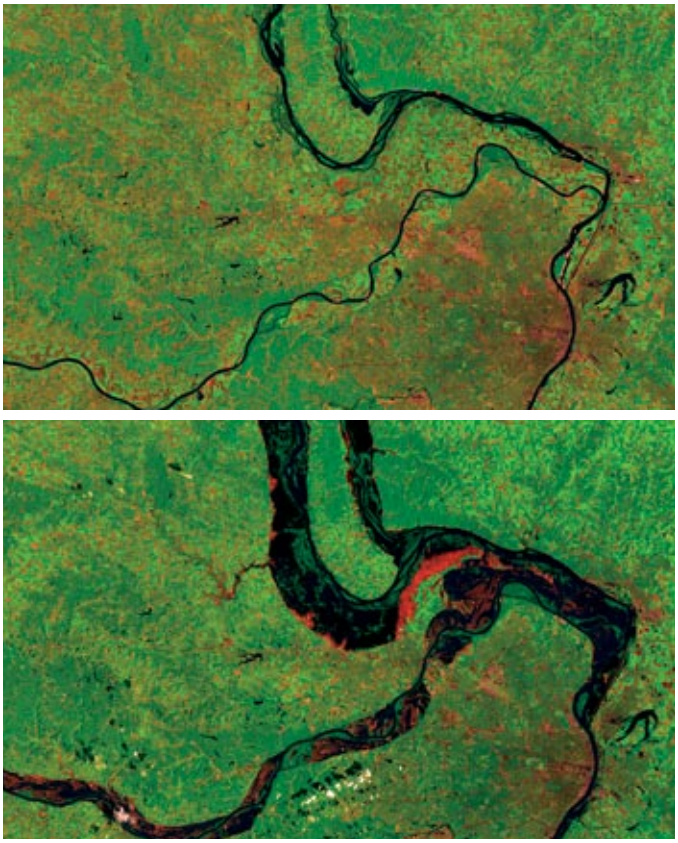
Deeper, slower-moving places in the stream channel are called **pools**. The shallow, faster-flowing places are called **riffles**. Healthy streams have riffle-pool-riffle sequences. These alternating slow and fast moving waters make great homes for aquatic life. Riffles mix oxygen into the water, which makes it better for the **invertebrates** living there. The invertebrates (mostly immature insects) provide a food source for fish.

But the channel is only one part of the stream. The **stream banks** are the shoulder-like sides of the stream channel—the part from the water's edge to the higher ground nearby. Stable stream banks have plenty of plants growing on them. The roots hold soil in place and minimize erosion. Stems and leaves slow the water and collect sediment. When a stream bank erodes, it can fill the stream's pools with sediment. Major erosion and sedimentation can smother aquatic life and destroy their habitat.

The **riparian zone** is the land next to the stream (starting at the top of the stream bank). A riparian zone with heavy plant cover 100 feet on either side of the stream may be the stream's best defense against pollution and other problems in the watershed. (FIG. 7.2) This zone buffers the stream from potential problems. Plants growing in the riparian zone keep the stream healthy in many ways. Trees

JIM RATHERT

FIG. 7.2—A plant-filled riparian zone is essential to stream health.



DATA PROVIDED COURTESY THE LANDSAT PROJECT SCIENCE OFFICE AT NASA/GODDARD SPACE FLIGHT CENTER

FIG. 7.3—Satellite photos of the St. Louis region where the Missouri and Mississippi Rivers meet show a normal year (top) and during the flood of 1993 (bottom).

shade and cool the water, which increases the amount of dissolved oxygen the water can hold. Shaded stream segments may be as much as 10 degrees cooler than segments exposed to direct sunlight. Roots help hold the stream banks together. Leaves and branches falling into the water provide organic matter for aquatic food webs. Riparian plants offer habitat to birds, bats and other wildlife.

Further out from the stream channel is the **floodplain**. This is the flat land on both sides of the river or stream. During a flood, a stream's extra water spreads out to cover the floodplain. (FIG. 7.3) Flooding is a natural characteristic of all streams. By allowing excess water to spread out, floodplains reduce the floodwater's speed. As a result, less damage occurs in the stream and to regions downstream. In Missouri, floods large enough to overflow into the floodplain occur about every two to two-and-a half years. People tend to forget the function of floodplains and build roads, houses and levees in them, resulting in property loss during floods. (FIG. 7.4) While we tend to think of floods as natural disasters, they are really natural events and processes that have positive effects on stream ecosystems. The only disaster comes when humans put things in the water's way.

Changing to stay the same

All of these parts make up the stream system. Each part works together. The stream system moves water and sediment, temporarily stores excess floodwater and filters and traps sediment and pollutants. It also recharges and discharges groundwater, purifies instream flows and provides habitat for plants and animals. All streams have a natural tendency to follow a zig-zagging path. This is the stream's way of reducing the water's downhill speed. Fighting this tendency by channelizing or straightening the stream worsens erosion and sedimentation as the stream tries to return to a natural path. The stream is always changing to keep a healthy balance. For example, when sediment from the watershed enters a stream, the water in the channel carries it and releases an equal amount of sediment somewhere else. This ongoing balance is important. When extreme flooding damages a stream, all its parts work together to return it to a balanced but ever-changing state.

Precipitation first collects at the top of the watershed, in the headwaters. From there water flows downhill in tiny trickles too small to create a permanent channel. When these trickles finally combine and begin carving a channel, they form a **first-order stream**, a small stream with no tributaries coming into it. First-order streams combine to form larger second-order streams. These larger streams combine to form even bigger third-order streams and so on. At its mouth, the Current River is a seventh-order stream; the Mississippi is a 10th-order stream when it empties into the Gulf of Mexico; the Amazon River, the world's largest, is a 12th-order stream by the time it reaches the Atlantic Ocean.

Stream order and aquatic communities

Knowing the order of a stream and whether it has a perennial or intermittent flow can help you understand what aquatic life it can support. (FIG. 7.5) In the headwaters of a stream, the water is shallow and there

JIM RATHERT

FIG. 7.4—The floodplain is really part of the river, as nature sometimes reminds us. (Jefferson City, 1993)

are few aquatic plants. This lack of resources limits the number of animals that can live there. Since there is little aquatic plant growth at the headwaters, animals at the bottom of the food web depend on what falls or is washed into the stream. Insects, such as immature stoneflies, chew and tear these leaves and stems into tiny bits. They are called **shredders**. Small pieces that are not eaten by shredders are eaten by **collectors** (for example, immature mayflies) that gather food. **Grazers** (snails, for example) appear further downstream. As the grazers feed, they turn leaves and other big chunks of plant matter into smaller bits, which are eaten by collectors (such as mussels). Most fish that live in headwater streams are small predators such as darters or minnows. They feed on other smaller animals, such as insect larvae. Since they also eat grazers and collectors, they search for areas where there are lots of kinds of insects.

Mid-level streams (stream orders three through five) have both rooted and floating aquatic plants, and many more types of animals have a niche in which to live. Grazers such as snails and water pennies eat the growing plants. Collectors increase with the varied plant life. As the water and plants increase, shredders begin to decrease. A large variety of fish species, including many fish from headwater streams, live in the mid-level streams. **Anglers** (fishermen) like to pursue fish living in these streams.

When streams meet, the water mixes and flows downstream. Individual characteristics of the smaller streams and nutrients from each watershed combine into a big river. Few rooted plants grow because the water is too deep and very cloudy. Here, there are more collectors than shredders. One major group of collectors in big rivers is mussels. Big river fish species in the collector category include paddlefish, shad and suckers. These large collectors specialize in eating smaller animals. Big river predators range in size from tiny plankton to 80-pound blue catfish.

Stream food webs are easily upset. Excess plant nutrients, such as fertilizers or animal waste, can cause algae growth that can choke the stream. Algae can multiply rapidly to cover the surface of the water, forming a shade that prevents the sunlight from getting through. Underwater aquatic plants then cannot photosynthesize food, so they begin to decay. Decomposition of dead plants removes oxygen from the water, causing fish to die.

Indicators of good water quality

Besides testing the physical and chemical characteristics of the water, water quality experts also look for certain invertebrates that live in riffles on the stream bottom. Examples include the immature stages of stoneflies, caddisflies and mayflies. These insects are sensitive to pollution. The presence of such species generally indicates good quality water. When they are missing from a stream or when only pollution tolerant species such as black fly larvae and bloodworms are present, we know that something is wrong with the water. Biodiversity—a high number of species—as well as a high number of sensitive species living in a stream are good signs of a healthy stream. (FIG. 7.6)

CLIFF WHITE

Soil and water conservationists

Soil and water conservationists work with farmers, ranchers and other land users to help them prevent erosion, improve water quality, manage nutrients and protect and preserve wildlife habitat. Agencies such as the Natural Resources Conservation Service, the Missouri Department of Conservation and local soil and water conservation districts hire people with degrees in soil science or related agricultural or natural resource fields.

JIM RATHERT

FIG. 7.6—Some stream insects such as this stonefly nymph are more sensitive to pollution than others. Their presence or absence in a stream can help us determine the stream's health.

Stream order determines aquatic community (FIG. 7.5)

A stream's order or size determines the aquatic community it can support. Headwaters, first- and second-order streams have no rooted or floating plants, so aquatic animals depend on debris that falls or is washed into the water. These conditions favor shredders and small fish. Third- through fifth-order streams have both rooted and floating aquatic plants and many more types of animals. In a big river, few rooted plants grow because the water is too deep and very cloudy. Big river conditions favor plankton, collectors and large fish.

Note: Images do not show plants' and animals' actual sizes.

Stream plants and animals have developed special adaptations for life in river and stream habitats. (FIG. 7.7) Plants living in moving water have long, thin, flexible stems that offer little resistance to the current and strong root systems to hold them in place. Mussels burrow to avoid the current and snails use a broad, flat foot to stick to rocks. Water birds have long legs for wading and hunting or webbed feet for swimming and diving. River otters have an oily coat to keep them dry and warm. Fish such as bleeding shiners have streamlined bodies that allow them to remain stable in currents. Sculpins and many darter species are adapted as bottom clingers. They tend to have flattened heads and large pectoral fins that are angled to help them stay on the bottom in swift currents. With these advantages they can stay in the swift water of riffles and pick invertebrates from the rocks.

The diversity of plant species and clean sources of water make the streamside or riparian woodlands attractive to wildlife. Nuts, fruits, roots and grass are among the useful products found in this type of habitat. Trees, grasses and other plants provide shelter and cover for many species of wildlife. Various-sized trees serve as specific habitats. After trees have died, their decaying logs provide shelter for snakes, rodents and other ground-dwelling species. Some animal species use riparian woodlands through all stages of their lives.

CLIFF WHITE

FIG. 7.8—Missouri: Where the rivers run

Enjoy Missouri streams

It's hard to imagine a better slogan for Missouri than "Where the rivers run." (FIG. 7.8) Streams zigzag across Missouri in ever-changing and fascinating but predictable patterns. They host a dazzling array of life. Canoe an Ozark stream or fish a big river and get in touch with just how precious these resources are. Then join a Missouri Stream Team and help clean up a stream in your community, learn to check water quality, learn more about watershed conservation, and take part in the many conservation activities offered.

DAVID BESENGER

FIG. 7.7—Healthy stream ecosystems support a dazzling array of living things.